

Department of Aeronautics and Astronautics

The [Department of Aeronautics and Astronautics \(AeroAstro\)](#) at MIT is among the nation's oldest and most highly regarded. With both undergraduate and graduate programs regularly ranked among the best in the country, the department is an ever-evolving, vibrant community of students, faculty, researchers, and staff.

As articulated in the department's 2020 Strategic Plan, our shared vision is the creation of an aerospace field that is a diverse and inclusive community, pushing the boundaries of the possible to ensure lasting positive impact on our society, economy, and environment.

Furthermore, we educate the next generation of leaders, creative engineers, and entrepreneurs who will push the boundaries of the possible to shape the future of aerospace. We do these things while holding ourselves to the highest standards of integrity and ethical practice. Working together with our partners in the public and private sectors, we aim to expand the benefits of aerospace to create a more sustainable environment, strengthen global security, contribute to a prosperous economy, and explore other worlds for the betterment of humankind.

With a shared set of values, ethics, and integrity, our mission can only be realized if we remain focused on leading through excellence in research and education while creating an open, diverse, inclusive, and supportive environment.

A Brief History of Aeronautics and Astronautics at MIT

The first appearance of an aeronautics class appeared in MIT's AY1914 course catalog. The course, titled Aeronautics and numbered 1,372, appears to have been taught in spring 1914.

During 1913, Jerome C. Hunsaker began to develop the aeronautics course. The Executive Committee of the Corporation voted to appoint Hunsaker instructor in Aviation, attached to the Department of Naval Architecture.

The faculty approved the schedule of studies needed to receive an SM in aeronautical engineering on April 22, 1914. The graduate course was listed and described on page 62 of the AY1915 course catalog, published in December 1914.

The first graduate of the nascent graduate course was Hou-Kun Chow, recommended for a master's degree in aeronautical engineering at Corporation's June 4, 1915 meeting. His name appears on a list of successful candidates for graduation in the AY1916 catalog, which incorrectly lists the graduates for 1915 as having graduated in June 1914. Chow's thesis also shows a date of 1915. There were no graduates of the Aeronautical Engineering course in 1914.

Hunsaker was recommended for a doctorate in engineering by vote of the Corporation on June 9, 1916. He also is listed among successful candidates for graduation in the AY1917 catalog, with a description of his doctoral studies appearing on page 430.

Another early graduate of the department was Wong Tsu, Class of 1916. Later to become the Boeing Company's first engineer, Tsu designed Boeing's first mass-produced product—the Model C training seaplane, putting the company on sound financial footing.

Course 16 was established as an independent course by vote of the Executive Committee of the Corporation on July 7, 1925. The minutes of the meeting state: "Voted: To establish Aeronautics as a separate course to be designated by a special number and to be under the direction of Professor E. P. Warner." The schedule of studies for the bachelor's degree in aeronautical engineering was approved at a faculty meeting on March 17, 1926. The establishment of Course 16 is mentioned on pages 16 and 17 of Reports of the President and Treasurer for the year ending June 30, 1926. The course first appeared listed in the AY1927 catalog.

Aeronautical Engineering became its own department in 1939. Minutes for a meeting of the Corporation's Executive Committee held on April 11, 1939 state: "Voted: To recommend to the Corporation the establishment of a separate Department of Aeronautical Engineering, with Professor Hunsaker continuing as Head of this New Department as well as Head of the Department of Mechanical Engineering." This was confirmed by a meeting of the Corporation on June 6, 1939. The minutes of the meeting stated: "Voted: That a separate Department of Aeronautical Engineering be and hereby is established, with Professor Hunsaker continuing as Head of this New Department as well as Head of the Department of Mechanical Engineering."

COVID-19 and the Department of Aeronautics and Astronautics

With Daniel Hastings, Cecil and Ida Green Professor in Education and department head, and Hamsa Balakrishnan, William E. Leonhard (1940) Professor and associate department head, the department struggled to adapt in a world held hostage to COVID-19. With the overwhelming majority of MIT's student body, staff, and faculty in a virtual lockdown and not permitted on campus, the Institute was constantly revising its policies and procedures as COVID-19 figures rose and fell. The world outside the Institute dictated what became our new normal. With hundreds of thousands critically ill, thousands dying, and intensive care units at capacity, MIT researchers feverishly worked to develop a vaccine.

In early March 2020, the Institute had largely shut down due to the pandemic. When possible, students were sent home to continue their studies online. Staff were asked to work remotely. Faculty were tasked with the onerous and incredible job of creating online course content within a few weeks' time. Even researchers were asked to leave their labs. All on-campus departmental activity halted from March 16, 2020, until the beginning of June when planning for the first phase of MIT's research ramp-up began. Only a handful of essential departmental staff were allowed limited access to campus prior to the start of Phase 1, which allowed for 25% occupancy of space by researchers. Building on the success of our planned and managed Phase 1 ramp-up, Phase 2 activities (50%) started at the end of August. Throughout the pandemic, the department has adhered to the MIT policy of "all work that can be done remotely must be done remotely."

While the how of education, research, and work at the Institute shifted, never did the Institute or the department fail to address the needs of its varied population. Senior leadership held virtual meetings multiple times per week with leadership across departments, labs, and centers, keeping everyone abreast of changes to protocol and the Institute's commitment to students and employees.

With COVID-19 and a world run amok as background, the department persevered. Focused on the health and well-being of its people, AeroAstro recommitted itself to building a stronger department. With regular department coffee hours—for all department cohorts, weekly staff check-ins with Administrative Officer Brian O'Conaill and Human Resources administrator Hannah Ovaska, shared virtual events, regularly scheduled invited speakers presenting via Zoom, virtual Wednesday faculty lunches expanded to include all department members, we sought to create a community that would thrive even in the absence of human contact. From online crossword puzzles to impromptu talks by guests, anything and everything became a reason for seeing one another on Zoom. This became especially critical during a year fraught with political and racial unrest; the department's people needed one another, and we sought to provide opportunities to connect.

COVID-19 and Course 16 Students

Of grave concern, at the outset of AY2021:

- 50% of Institute students reported experiencing an increase in stress
- 47% felt that Zoom lessons had been ineffective, with 80% reporting they were unable to focus as well as in in-person classes
- 55% reported they were not collaborating as much as before the transition to online learning
- 88% of students felt a decrease in the quality of campus interactions with friends

In fall 2020, labs and classes that required access to facilities and other on-campus resources to build and operate experiments were prioritized as the Institute phased in a return to campus. In the fall, all classes were held online (even if also offered in person) so students could learn wherever they are most comfortable. Research and administrative work that could be done remotely continued to be done remotely. Those cleared to return to campus were required to comply fully with Institute requirements around mandatory testing, public health training, and wearing personal protective equipment.

Those students invited to campus in fall 2020 included rising seniors, given that they had the least flexibility to satisfy degree requirements and because being on campus is especially important for essential work in programs ranging from capstone subjects to lab research and theses. Other students welcome on campus—some who had never left during the otherwise mass exodus in March 2020—were those whose circumstances required special consideration in terms of their safety, living conditions, visa status, or additional hardships.

During fall 2020, all department classes were offered via Zoom, with the following hybrid exceptions:

- 16.821 Flight Vehicle Development
- 16.887 Technology Roadmapping and Development
- 16.851 Satellite Engineering

Little changed in spring 2021, with only a different cohort of students permitted on campus; this included all first years, sophomores, and juniors, with seniors living near campus given access to Institute facilities. With few exceptions, classes remained virtual. The department offered the following in-person classes:

- Unified Engineering Flight Competition
- 16.405J/6.4200J Robotics: Science and Systems
- 16.821 Flight Vehicle Development
- 16.36/16.363 Communications Systems and Networks

People

Here is a snapshot of the count of department faculty, students, and postdoctoral researchers in fall 2020:

- Faculty: 38—10 women, 7 people from underrepresented minority groups (URMG)
- Undergraduates: 176 —64 women, 52 from URMG
- Graduate students: 241
 - SMs: 102—36 women, 14 from URMG
 - PhDs: 139—22 women, 12 from URMG
- Postdocs: 18—5 women, 0 from URMG

Faculty

Those in department leadership positions for the academic year were Daniel Hastings (department head), Hamsa Balakrishnan (associate department head), Nicholas Roy (Computing Sector head), Paulo Lozano (Space Sector head), and Steven Barrett (Air Sector head).

Tenure and tenure-track faculty in the department are as follows:

Hamsa Balakrishnan (professor)

Steven Barrett (professor)

Kerri Cahoy (associate professor)

Luca Carlone (assistant professor)

Zachary Cordero (assistant professor; Boeing Professor)

Edward Crawley (professor; Ford Foundation Professor of Engineering)
 David Darmofal (professor; Jerome C. Hunsaker Professor)
 Olivier de Weck (professor)
 Mark Drela (professor; Terry J. Kohler Professor)
 Chuchu Fan (assistant professor; T. Wilson (1953) Professor)
 Edward Greitzer (professor; H. N. Slater Professor in Aeronautics and Astronautics)
 Carmen Guerra-Garcia (assistant professor; Atlantic Richfield Career Development Professor in Energy Studies)
 Steven Hall (professor)
 R. John Hansman (professor; T. Wilson (1953) Professor in Aeronautics)
 Wesley Harris (professor; Charles Stark Draper Professor of Aeronautics and Astronautics)
 Dan Hastings (professor; Cecil and Ida Green Professor in Education)
 Jonathan How (professor; Richard Cockburn Maclaurin Professor in Aeronautics and Astronautics)
 Sertac Karaman (associate professor)
 Paul Lagacé (professor)
 Nancy Leveson (professor)
 Richard Linares (assistant professor; Charles Stark Draper Professor)
 Paulo Lozano (professor; M. Alemán-Velasco Professor)
 Adrian Lozano-Duran (assistant professor)
 Youssef Marzouk (professor)
 David Mindell (professor; Frances and David Dibner Professor in the History of Engineering and Manufacturing)
 Eytan Modiano (professor)
 Dava Newman (professor; Apollo Professor of Astronautics and Engineering Systems)
 Jaime Peraire (professor; H. N. Slater Professor in Aeronautics and Astronautics)
 Raúl Radovitzky (professor)
 Nicholas Roy (professor)
 Julie Shah (associate professor)
 Zoltán Spakovszky (professor)
 Ian Waitz (professor; Jerome C. Hunsaker Professor)
 Qiqi Wang (associate professor)
 Brian Wardle (professor)
 Brian Williams (professor)
 Moe Win (professor)

Professors of the practice are Jeffrey Hoffman (100%) and Robert Liebeck (5%). Faculty with a joint appointment in the department are Professor Richard Binzel (Department of Earth, Atmospheric and Physical Sciences [EAPS] as primary); Professor Sara Seager, Class of 1941 Professor of Planetary Sciences (EAPS and Physics as primary); Professor Russell Tedrake, Toyota Professor (Department of Electrical Engineering and Computer Science as primary); and Assistant Professor Danielle Wood (Media Lab as primary).

New Faculty

- Zachary Cordero joined the department at the assistant professor rank effective July 1, 2020. Cordero specializes in the following areas: additive manufacturing, structural materials, and materials processing for aerospace applications.
- Chuchu Fan joined the department at the assistant professor rank effective July 1, 2020. Fan specializes in the following areas: safe autonomy, cyber-physical systems, formal methods, control theory, and embedded systems.
- Adrian Lozano-Duran joined the department at the assistant professor rank effective December 2020. Lozano-Duran specializes in computational fluid dynamics and turbulence modeling.

Faculty Promotion and Reappointment

Promotion cases presented during AY2021 with promotions becoming effective July 1, 2021:

- Julie Shah promoted to full professor
- Luca Carlone promoted to associate professor without tenure

Professor of the practice reappointment case presented during AY2021 with renewal effective July 1, 2021:

- Robert Liebeck (5%)

Department Sectors

Department leadership reorganized the sectors, creating three new sectors: Computing, Space, and Air.

Individually and collectively, sectors are responsible for organizing teaching coverage, undertaking graduate admissions, making recommendations to the Faculty Search Committee, and managing the graduate fields of study.

Sector heads are responsible for leading their respective sectors/clusters, serving on all faculty assessment committees, and other leadership duties, as assigned.

The Computing Sector consists of 19 primary faculty/researchers: Nicholas Roy (sector head), Hamsa Balakrishnan, Luca Carlone, David Darmofal, Chuchu Fan, Robert Haimes, Steven Hall, Jonathan How, Sertac Karaman, Youssef Marzouk, David Mindell, Eytan Modiano, Jaime Peraire, Raúl Radovitzky, Julie Shah, Qiqi Wang, Brian Williams, Moe Win, and new faculty member Adrian Lozano-Duran. Three secondary faculty serve in the sector: Olivier de Weck, Mark Drela, and John Hansman.

The Space Sector is composed of 16 primary faculty/researchers: Paulo Lozano (sector head), Kerri Cahoy, Zachary Cordero, Edward Crawley, Olivier de Weck, Daniel Hastings, Jeffrey Hoffman, Richard Linares, Manuel Martinez-Sanchez, Rebecca Masterson, David Miller, Dava Newman, Charles Oman, Alvar Saenz-Otero, Brian Wardle, Sheila Widnall, and Laurence Young. Secondary faculty in the sector are: Steven Barrett, Carmen Guerra-Garcia, Wesley Harris, Nancy Leveson, and Zoltán Spakovszky.

The Air Sector consists of 16 primary faculty/researchers: Steven Barrett (sector head), Peter Belobaba, Mark Drela, Edward Greitzer, Carmen Guerra-Garcia, Robert Haimes, John Hansman, Wesley Harris, Paul Lagacé, Nancy Leveson, Ngoc Cuong Nguyen, Amedeo Odoni, Jayant Sabnis, Zoltán Spakovszky, Raymond Speth, Choon Tan, and Ian Waitz. Secondary faculty in the sector are: Hamsa Balakrishnan, David Darmofal, Nancy Leveson, David Mindell, Jaime Peraire, and Qiqi Wang.

Visiting Faculty

Richard K. Miller, professor of mechanical engineering and president emeritus of Olin College, served as Hunsaker Visiting Professor of Aerospace Systems for AY2021.

Faculty Search

Awarded a single position to be announced by the dean of the School of Engineering, the department proceeded to form a Faculty Search Committee, chaired by Youssef Marzouk. The department conducted a broad search and solicited applications in all areas related to aerospace engineering while simultaneously highlighting the department's particular interest in candidates with expertise in the interaction of humans and autonomy; environmental modeling, monitoring, and mitigation, including considerations in the design of aircraft and propulsion systems; and bioastronautics and human exploration of space. A total of 65 complete applications were received, and applications were considered complete only when including three letters of reference. Six candidates were invited to interview; one candidate declined and withdrew her application, having resolved to accept a position elsewhere. Of note, three of the candidates worked in bioastronautics, one in space systems, and one in hypersonics. The remaining five candidates interviewed with the committee over a three-day period via Zoom, given constraints on travel and the fact that the MIT campus remained closed to most visitors, with faculty and staff working remotely. Research presentations were open to all faculty, with recordings made available to those unable to attend. Following extensive conversation and consideration, the committee arrived at the decision to make no offers. Two individuals who applied (one of whom interviewed) were considered worthy of hiring into postdoc positions to determine how they advanced and matured. The dean of the School of Engineering has allowed the department to carry over the TBA position into the FY2023 search.

Select Accomplishments and Achievements

- Following a long and illustrious career, Institute Professor Sheila E. Widnall retired in August 2020. From first female faculty member in the School of Engineering to her tenure as secretary of the Air Force to member of the Columbia Accident Investigation Board, Widnall never ceased to accept new challenges, shattering glass ceilings and stereotypes. On September 30, 2020, the

MIT community came together to celebrate her 64-year career at MIT. The virtual event featured remarks from MIT leaders, current and former secretaries of the US Air Force, and Widnall's faculty colleagues from the department who spoke of her impact at MIT and beyond.

- Effective July 1, 2020, the following faculty were recognized with endowed chairs: Hamsa Balakrishnan in the William E. Leonhard (1940) Chair (provost chair); Luca Carlone in the Leonardo Career Development Chair (School of Engineering chair); David Darmofal in the Jerome Hunsaker Chair (department chair); and Carmen Guerra-Garcia in the Atlantic Richfield Career Development Professor in Energy Studies (provost chair).
- Kerri Cahoy was appointed a Raymond L. Bisplinghoff Fellow, effective July 1, 2020.
- Moe Win was elected to the grade of associate fellow, Class of 2021 of American Institute of Aeronautics and Astronautics (AIAA), which recognizes individuals of distinction who have made notable and valuable contributions to the arts, sciences, or technology of aeronautics or astronautics.
- Jonathan How received a Distinguished Member Award from the Institute of Electrical and Electronics Engineers (IEEE) Control Systems Society (CSS), which recognizes significant technical contributions or outstanding long-term service to the IEEE CSS.
- Julie Shah and Laura Major SM '05 co-wrote a book urging designers to rethink not just how robots fit in with society but also how society can change to accommodate these new, working robots. *What to Expect When You're Expecting Robots: The Future of Human-Robot Collaboration*, was published in late 2020 by Basic Books.
- Olivier de Weck's Advanced Space Technology Roadmapping Architecture proposal was selected by the NASA Space Technology Mission Directorate.
- Richard Linares received a Defense Advanced Research Projects Agency Young Faculty Award, which provides funding, mentoring, and industry and Department of Defense contacts to awardees early in their careers so they may develop their research ideas in the context of national security needs.
- Jonathan How received the 2020 Amazon Web Services Machine Learning Research Award for his proposal "Fast Adaptation via Meta-Learning in Multiagent Reinforcement Learning."
- Wesley Harris and Jarunee Wonglimpiyarat received the 2020 Emerald Literati Award for their paper, "Blockchain Platform and Future Bank Competition."
- Danielle Wood has been invited to serve on the newly formed International Space Station National Laboratory User Advisory Committee.
- Sara Seager has been named an officer of the Order of Canada, one of the country's highest civilian honors, as recognition "for her multidisciplinary research that has contributed to transforming the study of extrasolar planets into a full-fledged planetary science."

- Daniel Hastings was named an Honorary Fellow by AIAA, joining others in the Class of 2021. Honorary Fellow is the highest distinction conferred by AIAA that recognizes preeminent individuals who have had long and highly contributory careers in aerospace and who embody the highest possible standards in aeronautics and astronautics.
- Olivier de Weck was named an AIAA Fellow, a title conferred upon individuals in recognition of their notable and valuable contributions to the arts, sciences, or technology of aeronautics and astronautics.
- Luca Carlone received a National Science Foundation CAREER Award for his research on certifiable perception for autonomous cyber-physical systems.
- Luca Carlone and Joshua Fishman's paper "Control and Trajectory Optimization for Soft Aerial Manipulation," was selected for the Track Best Paper Award by the IEEE Aerospace Conference Best Paper Committee and Track 9 organizers.
- Raúl Radovitzky received the Arthur C. Smith Award. Established in 1996 on the occasion of Dean Smith's retirement from the position of dean for Undergraduate Education and Student Affairs, the award is presented to a member of the MIT faculty for meaningful contributions and devotion to undergraduate student life and learning at MIT.
- Carmen Guerra-Garcia received the Earll M. Murman Award for Excellence in Undergraduate Advising, which is presented to a faculty member who has served as an excellent advisor and mentor for undergraduates and who has had a significant impact on their personal lives and academic success.
- Carmen Guerra-Garcia was additionally among the awardees recognized by the Office of Naval Research recognized as part of their Young Investigator Program.
- Olivier de Weck and his co-authors were awarded the Best Paper of the Year Award for 2020 by the journal *Systems Engineering* for their paper "Handling the COVID-19 Crisis: Toward an Agile Model-Based Systems Approach."

Research Volume

The department's research volume for FY2021 was \$33.2M, consistent with the FY2020 figure. Of the \$33.2 million, \$24.5 million was administered by the department.

Students

Promoting Excellence in Graduate Education

AeroAstro received 1,080 applications for admission to its graduate programs for fall 2021 and admitted 101 applicants (including eight students in the Leaders for Global Operations [LGO] program). Of the 101 admitted, 68 (including four LGO) enrolled and eight deferred, for a yield of 67%. Of the entering class, 35% were women and 10% were from underrepresented minority groups.

Department of Aeronautics and Astronautics Application and Enrollment Statistics, 2012–2021

Academic year	Applicants	Admitted	Accepted (%)	Enrolled	Yield (%)
2012	515	116	23%	80	69%
2013	549	90	16%	64	71%
2014	526	93	18%	70	75%
2015	561	80	14%	59	74%
2016	618	87	14%	59	68%
2017	638	90	14%	66	73%
2018	721	109	15%	71	65%
2019	725	89	12%	57	64%
2020	797	108	14%	76	70%
2021	1080	101	9%	68	67%

Department of Aeronautics and Astronautics Entering Class Women and Underrepresented Minority Group Statistics, 2015–2021

Academic year	Women	Students from underrepresented minority groups
2015	20%	10%
2016	15%	6%
2017	24%	10%
2018	32%	11%
2019	31%	12%
2020	36%	16%
2021	48%	23%

In fall 2020:

- SM students: 101
- PhD students: 152
- Of the total 253 graduate students in the department, 65 (25.7%) were women, 35 (13.8%) were from URMG, and 89 (35.2%) were international students (nonimmigrant [F-1] student visa)

US News & World Report Graduate Program Rankings, AY2012–AY2021

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
MIT	1	2	1	1	1	1	2	1	1	1
Stanford University	3	1	3	2	2	2	1	3	1	3
California Institute of Technology	1	2	1	2	2	4	4	1	3	1
Georgia Institute of Technology	4	4	5	5	5	2	2	4	4	4
University of Michigan	5	5	3	4	4	4	5	5	5	5
Purdue University	6	6	6	5	6	6	6	6	5	6
University of Illinois Urbana-Champaign	7	7	7	7	7	8	9	8	7	7
University of Texas at Austin	10	8	8	8	8	7	8	8	7	9
Princeton University	7	8	9	9	11	12	10	8	9	9
Texas A&M University	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8
University of Colorado Boulder	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9

Promoting Excellence in Undergraduate Education

Like the department's graduate program, the undergraduate program is among the best in the nation and is consistently ranked number one by *US News & World Report*.

US News & World Report Undergraduate Program Rankings, AY2012–AY2021

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
MIT	1	1	1	1	1	1	1	1	1	1
Georgia Institute of Technology	2	2	2	3	2	2	2	2	2	2
California Institute of Technology	5	5	7	4	5	6	5	3	3	3
University of Michigan	3	3	3	2	3	3	2	4	4	5
Purdue University	4	4	6	5	4	4	6	5	5	4
Stanford University	6	6	4	6	6	5	4	6	5	8
University of Illinois Urbana-Champaign	7	8	5	7	7	7	6	7	9	5
The University of Texas at Austin	12	7	8	9	10	8	8	8	7	9
Embry-Riddle Aeronautical University	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8	5

The department remains committed to promoting undergraduate research and hires students through the Undergraduate Research Opportunity Program (UROP). In AY2021 (including summer 2021), Course 16 had 327 UROP positions, of which 54 (17%) were first-year students. The department also continues to participate in the School of Engineering SuperUROP program and hires two to four students annually, with sponsorship of the \$10K SuperUROP coming from either an annual gift from the Boeing Company or internal coffers.

Graduate Student Awards and Acknowledgements

- Elwyn Sirieys won the Space Sustainability Summit essay competition in the category Future US–China Engagement in Space.
- Stewart Issacs received a Hugh Hampton Young Fellowship administered by MIT’s Office for Graduate Education. The fellowship recognizes academic achievement across multiple disciplines and honors students who possess exceptional character strengths and harbor outstanding potential to make a positive impact on humanity.
- Sandeep Badrinath, Chris Chin, and Karthik Gopalakrishnan, with former visiting student Dun Yuan Tan (MIT-Imperial Exchange) received Best Paper Awards at the International Conference on Research in Air Transportation.
- Paula do Vale Pereira was named a Rising Star in Mechanical Engineering, a joint effort between MIT, Stanford, and University of California, Berkeley to support senior grad students and postdocs considering a career in academia.
- Maya Nasr received an AIAA Best Paper Award for her submission, “Evolution of the Flight Crew and Mission Control Relationship,” which she produced as part of the MIT 16.895 Engineering Apollo class.
- Carmen Ursachi and Marshall Galbraith (research engineer) co-authored a paper with colleagues from Boeing, NASA, and the *Institut de recherche en informatique et en automatique*, or Inria [National Institute for Research in Digital Science and Technology], which has received the Shahyer Pirzadeh Memorial Award for the Outstanding Paper in Meshing Visualization and Computational Environments by the AIAA.
- Cadence Payne was among the 20 women selected for the WISDM Fellowship Program, which promotes the visibility of women in the MIT academic community, increases gender diversity in innovation and entrepreneurship, and makes it easier to find talented and diverse speakers for various events.
- Amelia Bruno received the Track Best Paper Award from the IEEE Aerospace Conference for her submission, “Design and Testing of a Propellant Management System for Bimodal Chemical-Electrospray Propulsion.”
- Hannah Tomio was selected as a NASA Space Technology Graduate Researcher.
- Thomas Roberts and Will Parker were awarded Graduate Research Fellowships from the National Science Foundation, which recognizes and supports outstanding graduate students who are pursuing full-time, research-based masters and doctoral degrees in science, technology, engineering, and mathematics (STEM) or in STEM education.
- Dan Jang received a Lincoln Scholarship starting in fall 2021.
- Paula do Vale Pereira received the TVML Fellowship, one of the competitive fellowships administered by the MIT Office of Graduate Education.
- Members of the Gas Turbine Lab were awarded this year’s American Society of Mechanical Engineers International Gas Turbine Institute Turbomachinery Best

Paper Award for the paper “Dynamic Model-Based Identification of Cavitation Compliance and Mass Flow Gain Factor in Rocket Engine Turbopump Inducers” by Yu Wan, Marco Manfredi, Angelo Pasini, and Zoltán Spakovszky.

- Chelsea Onyeador was recognized as an awardee and Thomas Roberts was recognized with an honorable mention by the 2021 Ford Foundation Fellowship Programs, which are administered by the National Academies of Sciences, Engineering, and Medicine. The programs seek to increase the diversity of the nation’s college and university faculties by increasing their ethnic and racial diversity, to maximize the educational benefits of diversity, and to increase the number of professors who can and will use diversity as a resource for enriching the education of all students.
- Together with their collaborators, Björn Lütjens and Brandon Leshchinskiy received a US Department of the Air Force MIT Artificial Intelligence Accelerator Directors’ Award “for cross-organization collaboration and curation of novel datasets, the visualization of forecasts, and the delivery of an innovative challenge problem.” Christopher Chin was among the group recognized with a US Department of the Air Force MIT Artificial Intelligence Accelerator Challenge Award “for the design and implementation of complex challenge problems to enable optimal aircrew scheduling.
- Chelsea Onyeador was named a MathWorks Fellow.

Undergraduate Student Awards

- Devin Johnson received the Albert G. Hill Prize, which is awarded to juniors or seniors from underrepresented minority groups who have maintained high academic standards and have made continued contributions to improving diversity, equity, and inclusion at MIT.
- Team 13—whose members included Naylah Canty, Jay Hilton, Austen Roberson, and Olivia Tobin—won first place in the annual Unified Flight Competition with a score of 55.1 g/s².

Postdoctoral Researchers

Promotions

- Luiz Acauan was promoted to research scientist.
- Kaveh Fathian was promoted to research scientist.

New Hires

- Christoph Falter, senior postdoctoral associate
- Guillaume Chossiere, postdoctoral associate
- Miguel Calvo-Fullana, postdoctoral associate
- Leonid Pogorelyuk, postdoctoral associate

Recognition

This year, we honored postdocs and researchers whose appointments concluded in 2020 and early 2021 and recognized them for their research and contributions to our community.

- Kayla Bicol, MIT Mapping Lab
- Anirban Chaudhuri, Aerospace Computational Design Laboratory (ACDL)
- Guillaume Chossière, Laboratory for Aviation and the Environment (LAE)
- Bianca Giovanardi, Institute for Soldier Nanotechnologies
- David Gondelach, Astrodynamics, Space Robotics, and Controls Laboratory/
Space Systems Laboratory
- Professor David Hall, Gas Turbine Laboratory (GTL)
- Sebastien Mannai, GTL
- Xinchun Ni, necstlab
- Professor Elaine Petro, Space Propulsion Lab (SPL)
- Paul Stegall, Human Systems Lab (HSL)
- Professor Vasileios Tzoumas, Sensing, Perception, Autonomy, and Robot
Kinetics Lab
- Yu Wan, GTL
- Professor Jakob Zech, ACDL

Staff

Hires, Promotions, and New Responsibilities

- Karen Bruce joined the department on a permanent basis as infrastructure assistant (reporting to Anthony Zolnik).
- Suxin Hu was promoted to the role of senior financial officer.
- Beata Shuster assumed additional responsibilities working in Human Resources.
- Robin Courchesne-Sato moved to Headquarters as an administrative assistant (reporting to the ADH).
- Pam Fradkin moved to the Gas Turbine Laboratory (reporting to Professors Greitzer and Spakovszky, and Senior Research Engineer Choon Tan).

Administrative and Support Staff Awards

- Elizabeth Zotos was honored with the Ellen J. Mandigo Award by the School of Engineering.
- Hannah Ovaska received the Golden Gatekeeper Award from the MIT International Scholars Office in honor of “her outstanding work on visa matters.”
- Marie Stuppard received an Infinite Mile Award from MIT Information Systems and Technology for her efforts overseeing transition and supervision of student

learning technologists who worked with Course 16 instructors to move their courses to the Canvas teaching platform.

Select Virtual Events

Annual Minta Martin Lecture (October 21, 2020)

Featuring Richard Martin, Jerome C. Hunsaker Visiting Professor of Aerospace Systems, MIT; professor and president emeritus, Olin College—“Thoughts on the Future of Higher Education: Lessons from 20 Years of Experimentation at Olin College”— is the 2020 annual Minta Martin Lecture.

The Minta Martin Lectureship is delivered in conjunction with a professorship established in honor of Jerome Clarke Hunsaker, one of the leaders in the field in aviation, and the first department head of MIT’s Department of Aerospace Engineering (the precursor of today’s Department of Aeronautics and Astronautics).

Virtual Holiday Party (December 11, 2020)

All members of the department were invited to join a virtual gathering while working from home. Those who expressed interest were sent holiday goodies in advance so the group could celebrate together. Word games and virtual tours of interesting sites entertained the partygoers, and the children of faculty, staff, and students were additionally able to join in the fun.

Annual Lester Durand Gardner Lecture (April 7, 2021)

Featuring Ellen Stofan, John and Adrienne Mars Director of the Smithsonian National Air and Space Museum, the Gardner Lecture is an annual lectureship made possible by a bequest of the late Major Lester D. Gardner—a member of the MIT Class of 1898—to sponsor annual presentations on aeronautical history.

SpaceTech 2021 (April 14, 2021)

Featuring a fireside chat with Gwynne Shotwell, student lightning talks, and a panel discussion on the future of human space exploration led by Dava Newman and featuring Charlie Bolden and others.

SpaceTech is AeroAstro’s technically oriented, future-looking event designed to inspire the next generation through interaction with the department’s people and their work.

Joint Event with MIT-Russia Program (April 20, 2021)

In a virtual event hosted jointly by the MIT-Russia Program—part of the MIT International Science and Technology Initiatives—and AeroAstro, astronaut Michael Fincke ’89 discussed his time as a student on campus, his experiences in both Russian and American space missions, and his advice for students interested in pursuing a similar career.

The Inaugural AeroAstro Postdoc and Researcher Award Ceremony (May 19, 2021)

Heretofore unrecognized for their contributions to the department, AeroAstro postdoctoral researchers are acknowledged and applauded for their labors.

May 26–28, 2021: Rising Stars in Aerospace Workshop

AeroAstro hosted the first Rising Stars in Aerospace, an academic career workshop for aerospace engineering that aims to increase the participation of people underrepresented among aerospace engineering professionals in academia and industry. Attendees presented their research during job talk starts and poster presentations, where they gained career skills, engaged with mentors, discussed emerging trends in aerospace engineering, and connected with a cohort of their peers.

AeroAstro Virtual Commencement (June 4, 2021)

The virtual Commencement is a one-hour tribute to undergraduate and graduate members of the Class of 2021, with special guests such as alumnus and moonwalker Charlie Duke and alumnus and Jet Propulsion Laboratory deputy director Larry James.

Diversity Efforts

With Paulo Lozano as faculty chair, AeroAstro’s Diversity, Equity, and Inclusion (DEI) Executive Committee has redoubled its efforts on diversity, equity, and inclusion, intent on taking a leading role at the Institute. The committee meets monthly to listen, gain feedback, and provide updates and actions about departmental inclusion initiatives. In order to ensure that diverse voices and opinions are represented at the meetings, the committee meetings are open to the entire AeroAstro community. Additionally, ad hoc task forces may be formed to address specific topics. In addition to the work of the committee, diversity officer Denise Phillips takes an active role in promoting awareness of DEI efforts across not only within the department but also in the School of Engineering. Phillips instituted a series of Blind Spots group discussions—conversations in areas in which we develop blind spots vis-à-vis diversity and inequity.

The department hosted a virtual DEI town hall, fielding questions from various stakeholders and inviting long-term participation in efforts to create a more diverse and inclusive community. One area that stood out was the discussion surrounding the prevalence of microaggressions at the Institute and within the department itself.

In a year where bias and discrimination seemed to take a backseat to only the pandemic, the department sought opportunities to expand outreach to different cohorts; in response to interest from a group of graduate students as well as support and administrative staff, the department supported the formation of an LGBTQIA affinity group. Although meeting only remotely during the academic year, the Queer Advocacy Space is a student group that provides a space where all members of the AeroAstro department are welcome, as well as allies and the LGBTQIA community alike.

Resource Development

In collaboration with the School of Engineering and Resource Development, the department and senior development officer Kate Reynolds created marketing materials and naming opportunities for the Wright Brothers Wind Tunnel (WBWT) to raise awareness of the project and share funding needs.

The Golden Paws Foundation, the family foundation of Wesley G. Bush '83 and his wife Natalie, endowed a graduate fellowship with a preference for supporting women and students from backgrounds underrepresented at MIT. This gift supports one of the top priorities of the department and is named in honor of Institute Professor Emerita Sheila Widnall SM '60, SB '61, ScD '64.

Infrastructure

During the reduced occupancy of departmental space, planning continued for the renovation of lab space for Professor Zachary Cordero in the basement of the Ronald E. McNair Building (Building 37). Additionally, a new lab space was designed to allow for work on the FireFly project; construction commenced in AY2021.

Under the watchful eye of Anthony Zolnik as manager of infrastructure, renovation of the Wright Brothers Wind Tunnel continued with an increased test section and a unique design with increased contraction to increase air flow. When complete (anticipated summer 2021), the wind tunnel will be the finest facility in academia. In preparation for the opening of the WBWT, the department will be searching for both an operations manager and business development person.

The department began the renovation process of the Human Systems Laboratory suite on the second floor of Building 37. Upon completion, the new space will house 24 graduate students and a reading room dedicated to bioastronautics, which will be named for Professor Larry Young to honor his contributions to the field and to MIT. The room will be called the Professor Larry Young Humans in Space Reading Room.

Communications

- Introduced last year, Roundup emails (an internal communications tool) have become a critically important form of communication for those in the department given the absence of an in-person workplace. A digest of news items that includes content submitted by the community—including awards, honors, fellowships, recent publications, media mentions, lab activities—as well as news articles, videos, and images gathered from external sources, the email is sent by the department head each month, with the exception of January and July (due to vacation schedules).
- Communications officer Sara Cody, along with partners Beata Shuster and Karen Bruce, have been working with contractor Opus Designs on website redevelopment in hopes of creating a new and fresh, user-friendly website for the department.
- The department introduced Popular Communication: Communicating STEM to the General Public, a new experiential learning opportunity that connects an AeroAstro undergraduate to our social media audience. Working closely with Communications officer Sara Cody, Michelle Luo (Course 16 student) developed social media content for our Facebook, Twitter, and Instagram feeds that highlight research, education, and life in the department.

Human Resources

Human Resources administrator Hannah Ovaska worked tirelessly to help visiting students and scholars navigate the labyrinth of rules and regulations throughout the pandemic, supporting all cohorts in the department.

The AY2021 Community Awards and Recognition Awardees

Graduate Student Ambassadors

Amelia Bruno	Hannah Tomio
Annick Dewald	Laurens Voet
Kevin Doherty	Carter Waligura
Max Li	Jerrold Wigmore
Andriana Mitchell	Syed Shayan Zahid
Hannah Munguia-Flores	

MIT AeroAfro Leaders

Arthur Brown
Cory Frontin
Cadence Payne
Chelsea Onyeador

Special recognition from their peers goes to:

- Cadence Payne is recognized for her leadership in organizing several AeroAfro virtual social gatherings, coffee chats with prospective AeroAstro graduate students, and one-on-one student mentorship meetings with some of the current first-year students.
- Chelsea Onyeador is recognized for her contributions in advocacy work across campus, including the Black Lives Matter Petition Support with the Black Graduate Students' Association.

MIT Department Resources for Easing Friction and Stress

Mycal Tucker
Victoria Preston
Syed Shayan Zahid

Special recognition from their peers goes to:

- Aaron Baumgarten, for his commitment to embody the values we all wish to emulate.
- Paula do Vale Pereira, for her organizational experience and the leadership she brings to the organization.

ga³ Executive Committee

Jon MacArthur	Hannah Tomio
Andrew Cummings	Andrew Fishberg
Cadence Payne	Ara Mahseredjian
Will Parker	Charles Dawson
Axel Garcia	Elwyn Sirieys
Maria Regina Apodaca Moreno	Harsh Bhundiya
Chelsea Onyeador	Alex Cabrales
Mary Dahl	Joey Murphy

Past ga³ executive board: Co-Presidents Adriana Mitchell and Prashanth Prakash; Vice President Lena Downes; Web Master and Social Media Chair Chelsea Onyeador; and Advocate for Gender Minorities Annick Dewald

Graduate Women in Aerospace Engineering Executive Leaders

Paula do Vale Pereira	Cassandre Pradon
Rosemary Davidson	Maria Regina Apodaca Moreno
Katie Carroll	Annick Dewald
Lena Downes	Amelia Gagnon
Chloé Gentgen	Jenny Gubner
China Hagström	Lucy Halperin
Rachel Morgan	Golda Nguyen
Hannah Tomio	

The Graduate Women in Aerospace Engineering executive leadership, along with others, have recognized two of their peers for their outstanding leadership: Annick DeWald and Sydney Dolan, for their advocacy on behalf of gender minorities and students on LGBTQIA issues.

Undergraduate Student Leadership Awards

- Admiral Luis de Florez Award: Savva Morozov
- General James H. Doolittle Prize: Robert Cato
- James Means Memorial Award: Julia Gaubatz
- Andrew J. Morsa Prize Award: Ethan Rolland
- Thomas B. Sheridan Award: Ethan Rolland

- Henry Webb Salisbury Award, given for superior academic performance by a Course 16 graduating seniors where the criteria to be considered include grade point average, performance in other curricular and extra-curricular activities, and feedback from faculty and advisors:
 - James Abel
 - Claire Buffington
 - Ngoc La
 - Dongjoon Lee
 - Dominic Maggio
 - Alex Meredith
 - Christopher Womack
- Yngve Raustein Award, an award named in memory of an MIT undergraduate of the Class of 1994 in recognition of their dedication to learning, both on-campus and off-campus, and their love of aerospace engineering: Class of Unified Engineering 2021–2022.
- Graduate Teaching Assistantship Award: Mary Dahl
- AIAA Professor of The Year Award: Raúl Radovitzky
- AIAA Graduate Teaching Assistant Award in an Undergraduate Subject (Unified Thermodynamics and Propulsion): Shun Zhang
- The Wings Award, recognizes an individual support member in AeroAstro for excellence:
 - Karen Bruce, infrastructure assistant
 - Esther Allen, administrative assistant
- The Spirit of XVI Award recognizes sustained excellence by a member of the staff or a team of staff members in AeroAstro whose work, commitment, and enthusiasm contribute significantly to the achievement of the mission of the department: Hannah Ovaska, Human Resources administrator
- The Upstander Award, recognizes a student, staff, faculty, postdoc, or researcher who speaks or acts in support of an individual cause that aligns with our values of leading through excellence in research and education; creates an inclusive environment; and/or fosters ethics, integrity, and success:
 - Denise A. Phillips, diversity officer
 - Maria Regina Apodaca Moreno, graduate student at the Space Enabled Group

Vickie Kerrebrock Awards

- Undergraduate Award: Devin Johnson
- Graduate Student Award: Chelsea Onyeador, graduate student, Hypersonics Research Lab

- Staff Award: Beth Marois, graduate program administrator
- Research/Postdoc Award: Maha Haji, postdoctoral associate
- Faculty Award: Hamsa Balakrishnan

AeroAstro Research Laboratories

The Aerospace Controls Laboratory (ACL) researches topics related to autonomous systems and control design for aircraft, spacecraft, and ground vehicles. Theoretical research is pursued in areas such as decision making under uncertainty; path planning, activity, and task assignment; estimation and navigation; sensor network design; robust control, adaptive control, and model predictive control. A key part of ACL is the Real-Time Indoor Autonomous Vehicle Test Environment, a unique experimental facility that uses a Vicon motion-capture sensor to enable rapid prototyping of aerobatic flight controllers for helicopters and aircraft; robust coordination algorithms for multiple helicopters; and vision-based sensing algorithms for indoor flight. Jonathan How is the lab's principal investigator (PI).

The Dynamics, Infrastructure Networks, and Mobility group conducts research on topics related to the modeling, analysis, control, and optimization of modern infrastructure systems, including air traffic networks, airports, advanced aerial mobility, aircraft emissions modeling and mitigation, control of networked systems, and congestion management in transportation systems. Hamsa Balakrishnan is the group's PI.

The Communications and Networking Research (CNRG) Group designs network architectures that are cost effective, scalable, and robust. CNRG is working on a wide range of projects in the area of networks and cyber-physical systems. An important aspect of the group's research is the development of architectures and algorithms that are optimized across multiple layers of the protocol stack. To that end, CNRG research crosses disciplinary boundaries by combining techniques from network optimization, machine learning, queueing theory, graph theory, network protocols and algorithms, and physical layer communications. Eytan Modiano is the group's PI.

There are three main thrusts to the research in the Model-Based Embedded and Robotics Systems group: goal-driven interaction with robots, natural human/robot teaming, and robotic reasoning about the environment. When combined, these research topics allow the creation of cognitive robots that can be talked to like another human, work with a team member to finish a task, recover from many failures without assistance, and collaborate with a human to recover from a failure that the robot cannot solve alone. Researchers enable these cognitive robot abilities by using model-based techniques. At the heart of these techniques are engineering models of how the robot works and models of how the robot's environment behaves. In addition to these models, researchers have developed algorithms that enable the robot to reason over how it believes the world works, much like humans do. Brian Williams is the group's PI.

The Reliable Autonomous Systems Lab designs, analyzes, and verifies safe control systems. Their work lies at the intersection of control theory, machine learning, and formal methods, with a particular focus on safety in systems with nonlinear, high-dimensional, and difficult-to-model dynamics. Chuchu Fan is the lab's PI.

The research goals of the Robust Robotics Group are to build unpersonned vehicles that can fly without a global positioning system (GPS) through unmapped indoor environments, robots that can drive through unmapped cities, and social robots that can quickly learn what people want without being annoying or intrusive. Such robots must be able to perform effectively with uncertain and limited knowledge of the world, be easily deployed in new environments and immediately start autonomous operations with no prior information. This engineering challenge will require algorithmic advances in decision-theoretic planning, statistical inference, and artificial intelligence. Researchers specifically focus on problems of planning and control in domains with uncertain models, using optimization, statistical estimation, and machine learning to learn good plans and policies from experience. Nicholas Roy is the group's PI.

The Space Telecommunications, Astronomy and Radiation Laboratory is part of the Space Systems Laboratory. Researchers in the lab achieve new scientific results from sensors on distributed, space-based platforms, innovating and using new commercial components to address technological challenges for future science missions, reducing cost and risk. Research focuses on weather sensing: development, operation, and analysis of data from nanosatellites that host miniaturized weather sensing instruments, such as microwave radiometers and GPS radio occultation receivers; connectivity: developing the ability to support high-rate crosslink communications with precision timing/ranging between a large number of resource-constrained individual nanosatellite agents; exoplanet detection and characterization; and nanosatellite technology. Kerri Cahoy is the lab's PI.

The Sensing, Perception, Autonomy, and Robot Kinetic Laboratory operates at the cutting edge of robotics and autonomous systems research, with the goal of enabling human-level perception and world understanding on mobile robotics platforms (drones, self-driving vehicles, ground robots) operating in the real world. Toward this goal, a combination of rigorous theory and practical implementations is employed. Particular research interests include nonlinear estimation and probabilistic inference, numerical and distributed optimization, and geometric computer vision applied to sensing, perception, and decision making in single and multirobot systems. Luca Carlone is the lab's PI.

The Wireless Information and Network Sciences Laboratory focuses on establishing a framework for cooperative network localization and navigation, determining the fundamental performance limits, developing distributed filtering algorithms, and designing error mitigation methods using measurement data. Cooperative network localization and navigation can achieve reliable and accurate location awareness, particularly in harsh environments. Moe Win is the lab's PI.

The Aerospace Computational Design Laboratory's mission is the advancement and application of computational engineering for the design, optimization, and control of aerospace and other complex systems. ACDL research addresses a comprehensive range of topics, including advanced computational fluid dynamics and mechanics; uncertainty quantification; data assimilation and statistical inference; surrogate and reduced modeling; and simulation-based design techniques. The lab's director is Youssef Marzouk. Additional researchers include faculty members David Darmofal, Mark Drela, Adrián Lozano-Durán, Jaime Peraire, and Qiqi Wang; principal research scientists Robert Haimes and Ngoc Cuong Nuyen.

The Astrodynamics, Space Robotics, and Controls Lab works at the intersection of astrodynamics, autonomy, and controls to further space exploration. The group's research topics include astrodynamics, space situational awareness and space traffic management, satellite guidance and navigation, estimation and controls, reinforcement learning, and optimal control. Richard Linares is the lab's PI.

The Computational Turbulence Group focuses its efforts on solving outstanding problems in physics and modeling of turbulent flows using transformative tools and creativity. Research is performed via rigorous mathematical theory combined with numerical simulation in state-of-the-art supercomputers. The applications of the group's research range from unpersonned aerial vehicles and commercial airliners to hypersonic vehicles. Current lines of investigations include dynamics of wall-bounded turbulent flows; and turbulence modeling for wall-modeled, large eddy simulation. Adrian Lozano-Duran is the group's PI.

The Design in Chaos group optimizes using simulations that exhibit chaotic dynamics, with particular interest in turbulent flows, simulated using high-fidelity computational fluid dynamics simulations. These include direct numerical simulation, large eddy simulation, and detached eddy simulation. Qiqi Wang is the group's PI.

Low-Energy Autonomy and Navigation (LEAN) is an interdisciplinary research group focusing on the co-design of algorithms and hardware for next-generation, low-energy autonomous vehicles. These vehicles include miniature robots, such as insect-size flyers, water striders, and chip-size satellites, as well as high-endurance vehicles that can operate months or years at a time, such as autonomous blimps, underwater gliders, soft robots, and printable robots. Autonomy capabilities for these vehicles will be unlocked by building their computers from the ground up and by co-designing the algorithms and hardware for autonomy and navigation. The LEAN research group has developed methods, algorithms, and computing hardware for visual-inertial navigation, motion planning, mutual information-based exploration, depth estimation, robot perception, and others. The group's PI is Sertac Karaman and its co-director is Vivienne Sze.

The Interactive Robotics Group (IRG) performs research in aid of creating a more harmonious human/robot interaction. In everyday settings, from factories to hospitals, it is increasingly common to see robots working alongside people. But because robots lack the intelligence to accommodate their more dynamic human partners, robots and humans work independently. In nearly every industry, the either/or tasking of people and robots results in massive inefficiency in producing goods and services. IRG seeks to enhance human capability to work with robots by designing machine intelligence that enables robots to work alongside humans as highly effective teammates. The group's vision is to harness the relative strengths of humans and robots to accomplish what neither can do alone. The group's PI is Julie Shah.

Founded in 1995, the Space Systems Laboratory engages in cutting-edge research projects with the goal of directly contributing to the present and future exploration and development of space. The objective of the laboratory is to explore innovative concepts for the design and integration of future space systems and to train the next generation of researchers and engineers. The lab's PI is Richard Linares while Dave Miller is on leave of absence. Other lab members include Rebecca Masterson and Alvar Saenz-Otero.

The Aerospace Plasma Group specializes in gas discharge and plasma physics phenomena, including their interaction with air- and space-borne vehicles, and as technological solutions to different aerospace challenges. By combination of experimental, analytical, and numerical methods, the group's work aims to transition from empiricism to design by analysis in disciplines that have traditionally relied on empiricism and testing (e.g., lightning strike protection of aircraft) and to facilitate the incorporation of plasma technologies in the aerospace field. Current research interests include lightning discharge to aircraft, nonthermal plasma technologies for combustion and propulsion, and the physics of different gas discharge regimes and their transitions. Carmen Guerra-Garcia is the group's PI.

The Engineering Systems Lab studies the underlying principles and methods for designing complex, socio-technical systems that involve a mix of architecture, technologies, organizations, policy issues, and complex networked operations. The group's focus is on aerospace and other systems critical to society, such as product development, manufacturing, and large-scale infrastructures. The lab's faculty director is Olivier de Weck. Its faculty members include Nancy Leveson, Daniel Hastings, and Edward Crawley. And Danielle Wood is an affiliated faculty to the lab.

- The System Architecture Group studies the early-stage technical decisions that will determine the majority of the system's performance and has helped architect systems from earth observation networks to lunar surface exploration vehicles.
- The goal of the System Safety and Cybersecurity Group is to create new tools and processes that will allow us to engineer a safer world. Engineering safer systems requires multidisciplinary and collaborative research based on sound system engineering principles, that is, it requires a holistic systems approach.
- The Strategic Engineering Research Group studies long-lived systems on Earth and in space. This includes the design and operation of critical infrastructures, such as industrial manufacturing, transportation, Earth observation, defense, water, and energy and food supply systems, as well as the challenges of sustained human and robotic exploration and settlement of outer space.
- The Systems Engineering Advancement Research Initiative seeks to advance the theories, methods, and effective practice of systems engineering applied to complex, socio-technical systems through collaborative research.

Research at the Gas Turbine Laboratory is focused on advanced propulsion systems and turbomachinery with activities in computational, theoretical, and experimental study of:

- loss mechanisms and unsteady flows in fluid machinery
- dynamic behavior and stability of compression systems
- instrumentation and diagnostics
- advanced radial fluid machinery for turbocharging, energy conversion, and rocket propulsion
- gas turbine engine and fluid machinery noise reduction and aero-acoustic

- novel aircraft concepts for reduced environmental impact
- hybrid-electric propulsion systems for electrified aviation and power generation
- multiphase and non-ideal fluid machinery design, such as supercritical carbon dioxide compressors

The lab's PIs are Zoltán Spakovszky and Edward Greitzer, with Choon Tan as senior research engineer.

The Human Systems Laboratory was originally founded in 1962 as the Man Vehicle Laboratory and was renamed in 2018. HSL performs research to improve the understanding of human physiological and cognitive capabilities to optimize human-system effectiveness and to develop appropriate countermeasures and evidence-based engineering design criteria. Research is interdisciplinary, using techniques from biomechanics, sensory-motor physiology, human performance assessment, human factors engineering, signal processing, artificial intelligence, and biostatistics. These methods are applied to space suit and exoskeleton design, wearable and virtual/augmented reality technologies, planetary mission resource utilization, space teleoperation, astronaut and pilot disorientation, artificial gravity, automation/autonomy, human-system task modelling, and display and control design. Systems evaluated include exoskeletons, aircraft, spacecraft, and vehicles. The lab's professor of the practice is Jeffery Hoffman.

The International Center for Air Transportation group has as its mission the improvement of safety, efficiency, capacity, and environmental performance of domestic and international air transportation and its infrastructure. With such a broad mandate, research areas are varied, including air traffic management; air transportation infrastructure and economics; aviation safety and weather; airline management and operations; human factors; flight instrumentation; and the environmental impact of aviation. The group's PIs are John Hansman, Hamsa Balakrishnan, Amedeo Odoni, and Peter Belobaba.

For more than two decades, the Laboratory for Aviation and the Environment and its predecessors at MIT have developed methods that help understand and quantify the environmental impacts of aviation and of cognate industries (e.g., transportation and energy). In addition, LAE researchers apply their methods to quantify the costs and benefits of operational, regulatory, and technological mitigation options to reduce these impacts. The LAE team also assesses and develops novel technologies that help reduce the environmental footprint of aviation. The team is focused on the following fields, climate; air quality; fuels; and technology. The lab's leadership include Steven Barrett as director, Raymond Speth as associate director, and Florian Allrogen as lab executive officer.

The Space Propulsion Lab has a strong program in both theoretical and experimental research in diverse types of propulsion systems and related technologies. It is because of the need to increase performance and reduce costs of space systems that a dynamic research environment in which advanced technologies are conceived and developed now flourishes, with a significant fraction of SPL's research focusing on the development and modeling of scalable space thrusters. Paulo Lozano is the lab's PI.

The Aerospace Materials and Structures Laboratory focuses its research on materials and manufacturing for extreme aerospace environments, pushing the boundaries of additive manufacturing for spaceflight through the development of new, net-shaping processes and materials. Current research interests include the design of additively manufactured, high-temperature materials for next-generation propulsion and thermal protection systems; and development of multifunctional, architected composites and truss structures for spacecraft. The lab's PI is Zachary Cordero.

The Hypersonics Research Laboratory (HRL) addresses aero-thermodynamic problem formulation and solutions, including but not limited to, plasma wakes, high-speed boundary layers, hypersonic vehicle configurations, and so on. HRL offers a balanced approach to better understand the behavior of external and internal high-speed flows through the application of small- and large-scale experiments, analytics, and simulation. The research foundations are drawn from applied mathematics, physics, and chemistry, with a strong focus on a first principles-based approach. The lab's PI is Wesley Harris.

The Nano-Engineered Composite Aerospace Structures Lab (necstlab, pronounced "next lab") research group explores new concepts in engineered materials and structures. The group's mission is to lead the advancement and application of new knowledge at the forefront of materials and structures understanding, with research contributions in both science and engineering. Applications of interest include enhanced (aerospace) advanced composites, multifunctional attributes of structures such as damage sensing, and also microfabricated topics. A significant effort over the past decade has been to use nanoscale materials to enhance performance of advanced aerospace materials and their structures through the industry supported Nano-Engineered Composite Aerospace Structures Consortium. (Brian Wardle is the lab's PI.

Daniel Hastings
Department Head
Cecil and Ida Green Professor in Education